

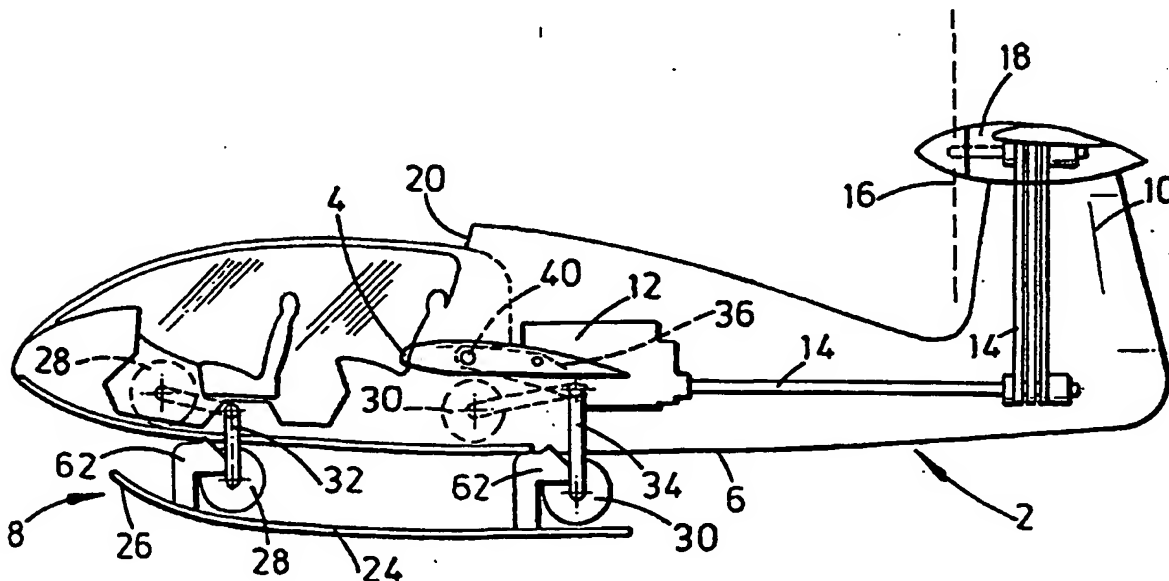
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<p>(21) International Application Number: PCT/GB93/02487</p> <p>(22) International Filing Date: 3 December 1993 (03.12.93)</p> <p>(30) Priority Data: 9225467.1 5 December 1992 (05.12.92) GB</p> <p>(71)(72) Applicant and Inventor: FISHER, Hugh, Edward [GB/GB]; Dunree Farm Cottage, Dalrymple, Ayrshire KA6 6BA (GB).</p> <p>(74) Agents: McCALLUM, William, Potter et al.; Cruikshank & Fairweather, 19 Royal Exchange Square, Glasgow G1 3AE (GB).</p>	<p>(81) Designated States: CA, GB, JP, KR, US, European patent (AT, BE, CH, DE, DK, ES, FR, GB, GR, IE, IT, LU, MC, NL, PT, SE).</p> <p>Published <i>With international search report.</i></p>	

(54) Title: AIRCRAFT CONSTRUCTION



(57) Abstract

The invention relates to an aircraft construction in which a retractable/extendable undercarriage assembly (8) of the aircraft fuselage (6) includes vanes (22, 24) which in normal flight lie flush with the fuselage contours in the manner of cladding panels. The vanes (22, 24) have tapering tip portions (26) similar to that of a water ski. The vanes (22, 24) may be moved from the flush condition into a water ski position to enable the aircraft to land or take off on water and further into an out-of-the way side position in which undercarriage wheels (28, 30) are lowered to a position in which they can contact a runway or, if landing on water, into a keel-like position to assist in manoeuvrability while taxiing on water.

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AIRCRAFT CONSTRUCTION

The invention is concerned with improvements in or relating to aircraft construction. In particular, the invention relates to aircraft having the capability of landing and take-off from both water and land.

Amphibious aircraft have conventionally been designed either as flying boats or as float-equipped aircraft. Such craft suffer drag and weight penalties compared with similar land-based aircraft, either from the configuration of the hull together with the reinforcement necessary for withstanding the force of water or from the presence of the floats and the struts and bracing of their mounting means.

The present invention provides an aircraft having a fuselage portion, within which is mounted a retractable/extendable undercarriage assembly comprising vane means adapted to contact the surface of a body of water during a take-off or landing operation, said vane means being adapted to present a lower vane surface to said body of water, wherein the vane means is movable between a first condition in which said means act as a cladding panel arrangement forming part of an aerodynamically shaped underneath surface of said fuselage portion and lying flush therewith, and a second condition in which said means are spaced from the fuselage portion to form a ski foil means comprising said lower vane surface.

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By the term "ski foil means" is meant a device adapted to skim over water in the manner of a water-ski or hydrofoil.

Advantageously, means may be provided to adjust the angle of presentation of said lower vane surface to the water to an oblique angle, a leading end of the surface being at a relatively high level with respect to a trailing end.

Conveniently, the leading end may be elevated to said high level, or, if preferred, said trailing end may be lowered to a level below said high level.

Conveniently, said vane means may comprise two elongate, parallel vane panels extending lengthwise of the fuselage portion and adapted to be movable into a third condition in which each panel lies in an at least substantially vertical plane to form a keel means when the aircraft is manoeuvring on water.

Advantageously, a further vane panel may be provided in the region of the nose wheel of the aircraft.

Conveniently, the vane panels may abut along lengthwise edges thereof when the aircraft is in flight and may pivot apart from one another separating at a longitudinal centre line of the vane means.

Advantageously, said undercarriage assembly further comprises a landing wheel arrangement.

In examples of aircraft according to the invention to be described below, the undercarriage assembly includes a

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main landing wheel or an arrangement of two landing wheels in tandem. In such an arrangement it will be appreciated that the wheel or the two wheels may be positioned directly above and aligned with said centre line of the vane means so that, when the vane panels separate, the wheel(s) may then come into contact with the ground.

It will however be understood that the invention is not limited to applications in which a tandem wheel arrangement is provided beneath the fuselage, but may also apply to a conventional arrangement in which a nose wheel arrangement is provided on the fuselage forward of two wheel assemblies comprising the main undercarriage. The two main wheel assemblies may be received in a main undercarriage or may be spaced apart and each stowable in one of two bays provided beneath the main aircraft body. It will also be appreciated that wheel assemblies mounted on the wings may be suitable for a high-wing multi-engine aircraft and may be adapted to take advantage of the present invention.

According to the arrangement is selected, the use of outrigger means may be found advantageous, both as float members and as auxiliary ski foil means.

It is envisaged that the present invention may be used not only on light aircraft but also with suitable larger aircraft, such as transport aircraft.

There will now be described an example of an aircraft according to the invention. It will be understood that

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the description, which is intended to be read with reference to the drawings, is given by way of example only and not by way of limitation.

In the drawings:

Figure 1 is a diagrammatic side view of an aircraft according to the invention;

Figures 2 and 3 are front view and underneath view respectively of the aircraft of Figure 1;

Figures 4 to 10 are side and front views illustrating the steps in a landing procedure by the aircraft on to a body of water;

Figures 11 to 14 illustrate the steps in a landing procedure on land;

Figures 15 and 16 are side views partly in section of landing wheels and ski foil mounting means in non-extended and extended conditions respectively;

Figure 17 shows the landing wheels on Figures 15 and 16 in a stowed condition;

Figures 18 and 19 are sectional views showing the operation of means to separate vane portions of the ski foil means;

Figure 20 is an exploded sequence of views including a bow-shaped member and the separating means of Figures 18 and 19; and

Figure 21 is a perspective view of a plurality of vane portions arranged on an aircraft of medium to large size.

An aircraft indicated at 2 in the drawings, comprises

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two wings 4, each having an aerodynamic cross-section, a fuselage portion 6 within which is mounted an undercarriage assembly, indicated at 8, and a tail portion, 10. An engine 12 is mounted centrally of the fuselage portion 6 and linkage 14 is provided to drive an air screw 16 set in the nacelle 18 of the tail portion 10 and operating about a longitudinal, horizontal axis. An air in-take to the engine 12 is provided at 20.

As may best be seen from Figures 2 and 3, the fuselage portion 6 includes vane means in the form of two panels 22,24 which lie flush with the general contours of the fuselage, acting as cladding panels to preserve the aerodynamically designed configuration. The panels 22,24 also act to close recesses from which the undercarriage assembly 8 may be lowered or retracted. Leading end portions of the panels 22,24 taper to a tip portion 26 similar to that of a water-ski.

The panels 22,24 are mounted on the undercarriage assembly 8 which further comprises two wheels 28,30 arranged in tandem on mounting legs 32,34 to move between a first condition in which they are received within the fuselage portion and a second position in which they are extended from the fuselage portion for take-off or landing. Figure 1 illustrates the wheels in their retracted condition in broken lines and in their extended condition in full lines. The wheel 28 is further mounted to enable the overall length of its mounting leg 34 to be

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increased as will be explained below.

Mounted for pivotal movement beneath each of the wings 4 is an outrigger means which comprises a float 36 which, in its retracted condition, lies substantially parallel to the underside of the respective wing but may be lowered about a forward end thereof to a position in which an under surface 38 forms a ski-like or planing surface.

Figures 4 to 10 describe a landing manoeuvre of the aircraft in which it alights on the surface of a body of water.

Figure 4 shows the aircraft 2 in flight, the panels 22,24 lying flush with the fuselage portion 6 and the wheels 28 and 30 of the undercarriage assembly 8 in a retracted condition within the fuselage portion 6.

Figures 5 and 6 show the undercarriage portion 8 lowered, so as to space the panels 22,24 downwardly away from the fuselage 6, by pivoting the mounting legs 32,34 and bringing the wheels 28,30 into the position shown. The outriggers 36 are also lowered about a forward pivot line 40 to the position shown. Figure 7 shows the lengthening of the mounting leg 34 to cause the panels 22,24 which are still in mutual abutment to present an inclined lower surface to a body of water 42 so that, on contact being made the panels acts as a vane member in the manner of a water-ski or hydrofoil. Figure 8 is a front view of Figure 7. The outriggers 36 then contact the water as the aircraft decelerates and settles in the water

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as shown in Figures 9 and 10, so that they act as buoyancy floats under the wings 4.

In order to improve manoeuvrability when afloat, the two panels 22,24 may then be swung apart about lengthwise extending axes so as to lie substantially in a vertical plane, forming a keel arrangement, see Figure 10. The presence of the keel arrangement is advantageous when the aircraft is required to taxi or otherwise manoeuvre on the surface of the water, since the aerodynamic contours of the fuselage offer little keel surface.

Figures 11 to 14 describes a landing manoeuvre of the aircraft upon a runway or other suitable area of flat ground. Figure 11 is similar to Figure 4 described above. In Figure 12, the wheels 28,30 and panels 22,24 are shown in a lowered condition similar to that shown in Figure 5, but for a ground landing the outriggers 36 are lowered to a position which brings auxiliary wheels 42 to the same level as the main wheels 28,30 for a four-point contact with the ground when landing is complete as shown in Figures 13 and 14. However, before the aircraft touches down, the panels 22 and 24 are pivoted into the previously described keel-forming position in order to expose the wheels 28,30.

The construction of the mounting leg 34 is shown in greater detail in Figures 15 and 16, in its normal and lengthened condition respectively. The leg comprises a sleeve 44 pivotally mounted at 46 to an undercarriage

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frame portion (not shown). A lower leg portion 48 adapted to provide shock-absorbing means is further provided with an external screw threaded member 50 so as to permit its axial movement through a rotary collar and bearing arrangement 52 provided at the lower end of the sleeve 44 and driven by a level gear 54 from an auxiliary hydraulic motor 56. A scissor-like brace 58 prevents relative rotation between the leg portion 48 and the sleeve 44.

A further auxiliary hydraulic motor 60 is mounted at the lower end of the leg portion 48 so as to operate the pivotal movement of the panels 22 and 24 as will be described below. This motor and its associated gearing is protected by a stream-lined, bow-shaped shield member 62 which comprises three portions, an upper semi-domed portion 64 and two side portions 66 and 68. The shield member 62 also protects mounting struts 70,72 for the panels 22,24 respectively.

It will be appreciated that when the wheel 30 is retracted into the undercarriage recess 25, the leg 34 is pivoted about the pivot point 46. However, the panels 22,24 remain substantially horizontal as shown in Figure 17 since the panel struts 70,72, the shield member 62 and the motor 60 with its gearing is mounted on a bracket 74 pivotally mounted on the axis of the wheel 30.

The gearing of the separation mechanism is shown in Figures 18 and 19, comprises two quadrant gears 76,78 secured to the struts 70,72 respectively, upper ends of

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which are rotatably mounted at 80 in the bracket 74. A worn gear drive member 82 operates from the motor 60 to cause the two panels 22,24 to separate, either to form a keel arrangement as explained above or simply to clear any obstruction to the wheels 28 and 30.

Figure 21 shows a larger size aircraft than those illustrated above, which is provided with three vane portions comprising the vane means. Such an aircraft has a housing 84 for a landing wheel arrangement and two vane portions 86 and 88 are provided in the housing. These portions are lowered when required to act as ski foils. A third vane portion 90 is provided at the nose portion 92 of the aircraft which is lowered to act as a forward ski foil.

Various modifications may be made within the scope of the invention as defined by the following claims.

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CLAIMS:

1. An aircraft having a fuselage portion, within which is mounted a retractable/extendable undercarriage assembly comprising vane means adapted to contact the surface of a body of water during a take-off or landing operation, said vane means being adapted to present a lower vane surface to said body of water, wherein the vane means is movable between a first condition in which said means act as a cladding panel arrangement forming part of an aerodynamically shaped underneath surface of said fuselage portion and lying flush therewith, and a second condition in which said means are spaced from the fuselage portion to form a ski foil means comprising said lower vane surface.

2. An aircraft as claimed in claim 1, wherein means are provided to adjust the angle of presentation of said lower vane surface to the water to an oblique angle, a leading end of the surface being at a relatively high level with respect to a trailing end.

3. An aircraft as claimed in either one of claims 1 and 2, wherein said vane means comprise two elongate, parallel vane panels extending lengthwise of the fuselage portion.

4. An aircraft as claimed in claim 3, wherein said vane means are adapted to be movable into a third condition in

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which each panel lies in an at least substantially vertical plane to form a keel means when the aircraft is manoeuvring on water.

5. An aircraft as claimed in either one of claims 3 and 4, wherein the vane panels are adapted to abut each other along lengthwise extending edges thereof when the aircraft is in flight, and are adapted to pivot apart from another separating at a longitudinal centre line of the vane means.

6. An aircraft as claimed in any one of the preceding claims, wherein said undercarriage assembly further comprises a landing wheel arrangement.

7. An aircraft as claimed in claim 6, wherein said undercarriage assembly comprises a landing wheel arrangement positioned directly above and aligned with said centre line of the vane means so that when the vane panels separate in use, the wheel arrangement is permitted to come into contact with the ground.

8. An aircraft as claimed in claim 7, wherein said landing wheel arrangement comprises main landing wheels.

9. An aircraft as claimed in either one of claims 3 and 7, wherein a third vane panel is provided in the region of a nose wheel arrangement of the aircraft.

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10. An aircraft as claimed in claim 7, wherein said landing wheel arrangement comprises two landing wheels in tandem.

11. An aircraft as claimed in any one of the preceding claims, wherein there are provided outrigger means adapted to act as float members and/or auxiliary ski foil means.

12. An aircraft as claimed in any one of claims 8 to 10, wherein said landing wheel arrangement comprises extension means for extending the overall height of said means when in use and to shorten said overall height when stowed, there being further means to pivot said landing wheel arrangement about an axis transverse of the aircraft.

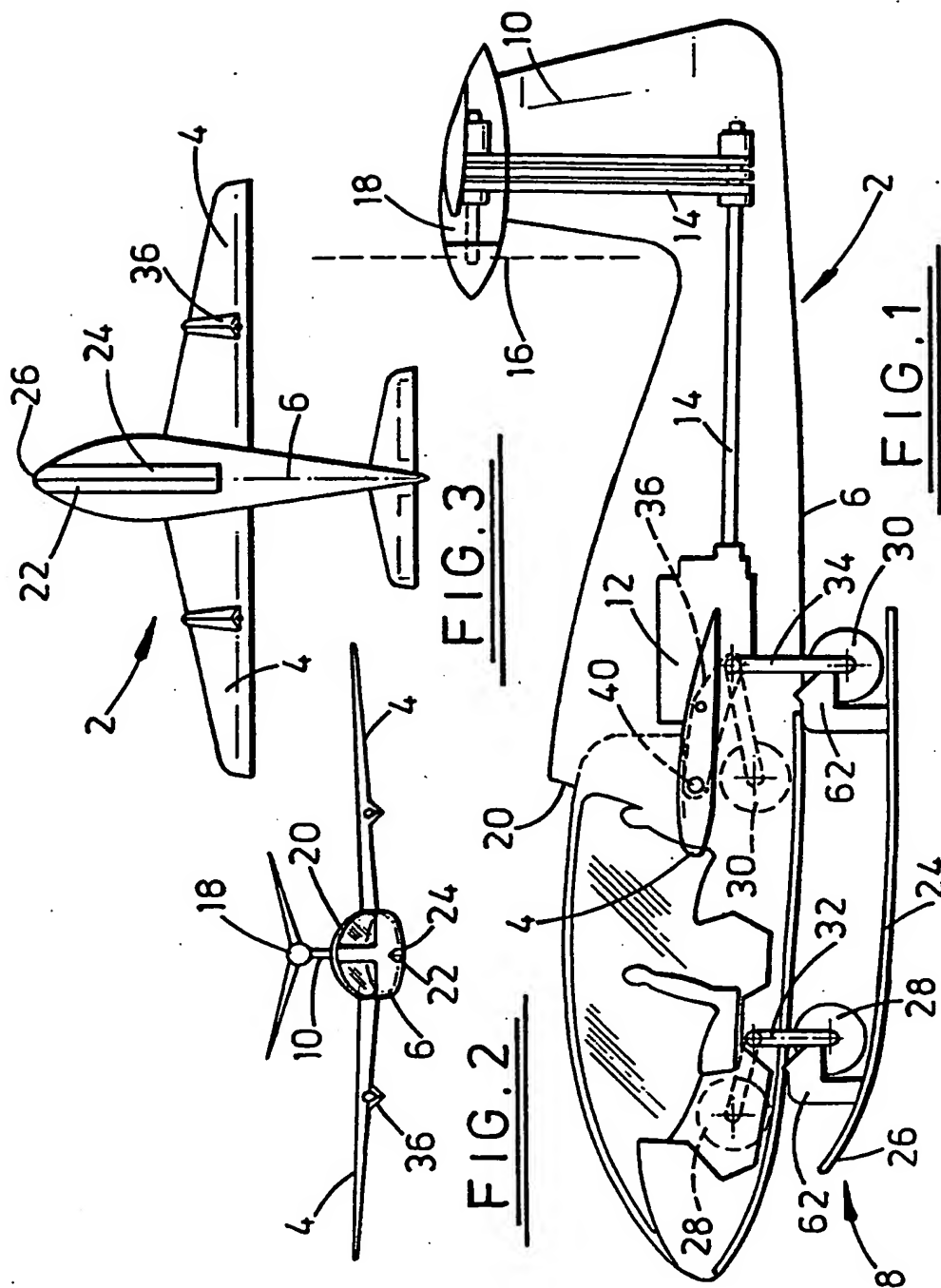
13. An aircraft as claimed in claim 12, wherein said vane members are mounted upon struts upper ends of which are pivotally mounted about a transverse axis of said landing wheel arrangement.

14. An aircraft as claimed in claim 13, wherein motor means for pivoting said vane members about lengthwise extending axes are mounted adjacent said struts and are operable through gearing to provide the pivotal movement.

15. An aircraft as claimed in claim 14, wherein said gearing comprises a quadrant gear arrangement.

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16. An aircraft as claimed in claim 15, wherein there is provided stream-lined shield means to protect said motor means from damage.



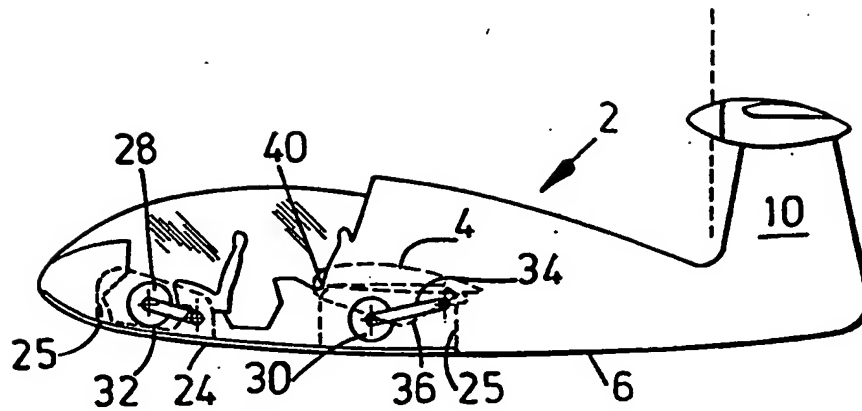


FIG. 4

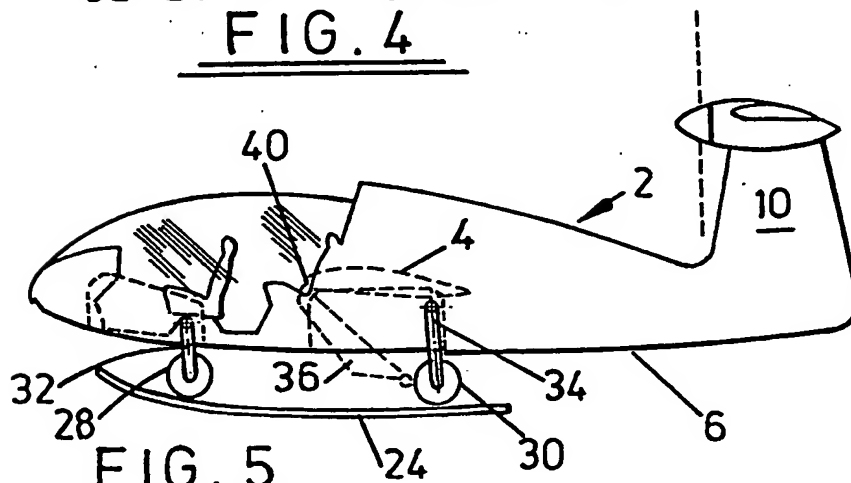


FIG. 5

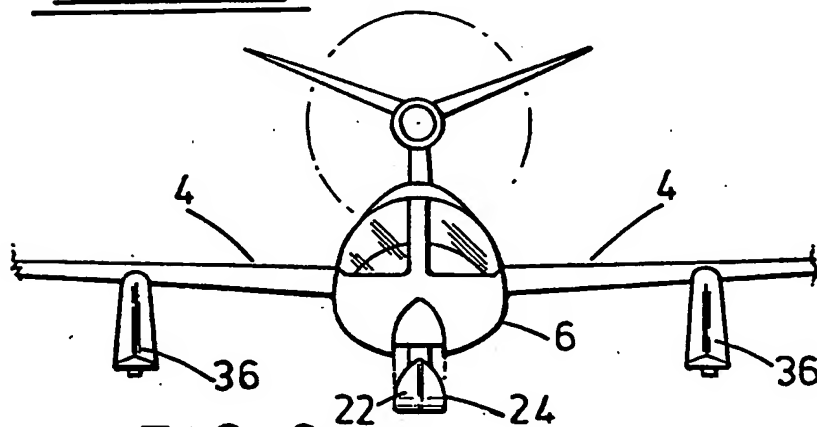
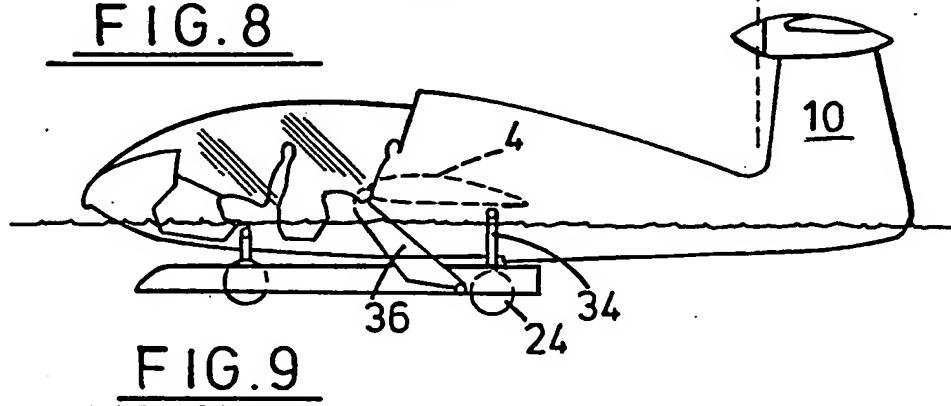
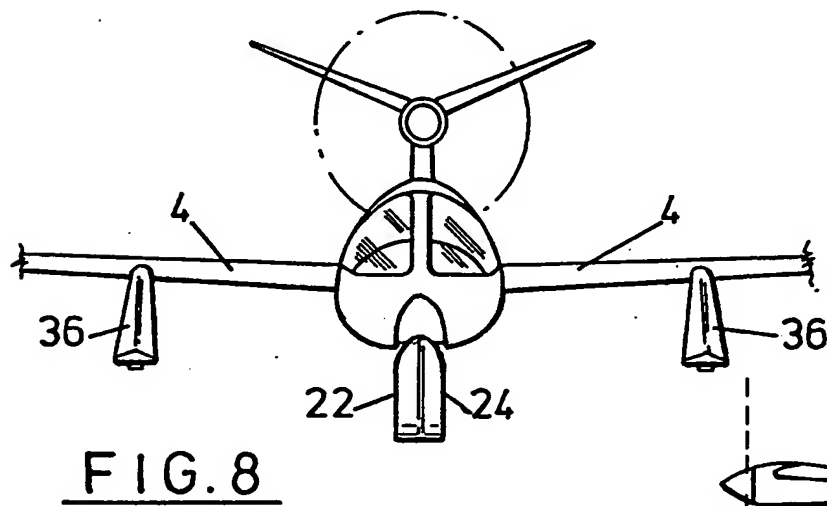
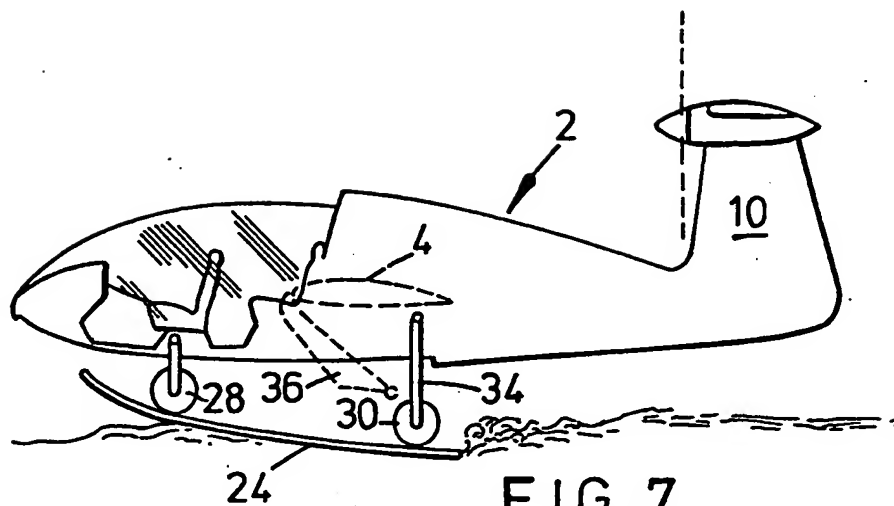


FIG. 6



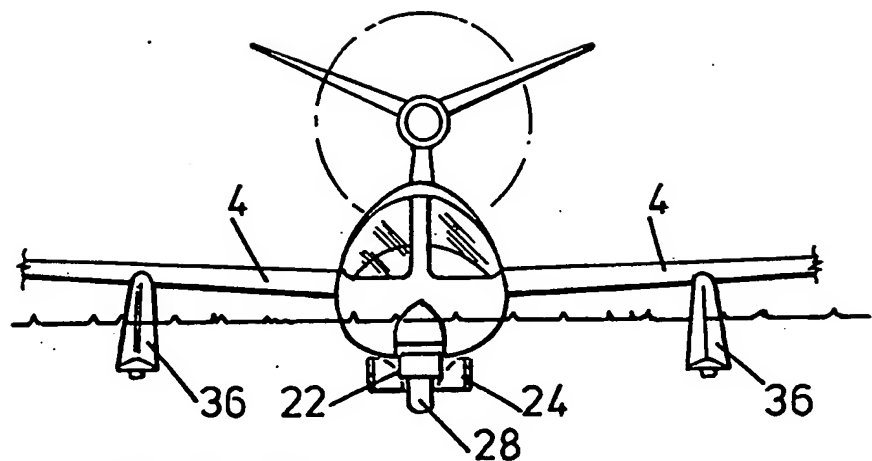


FIG. 10

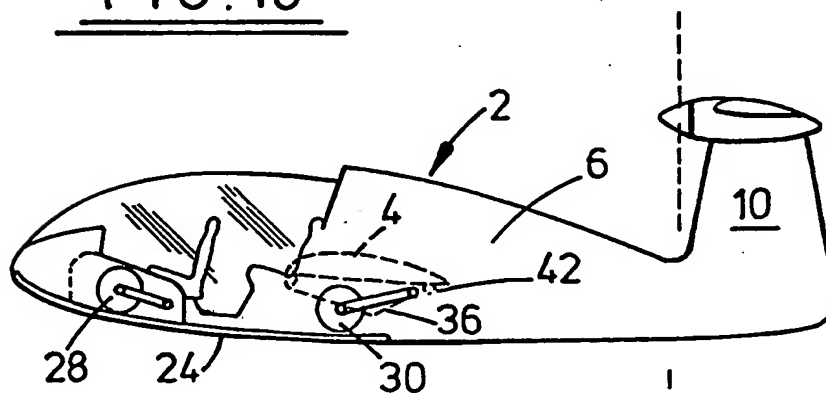


FIG. 11

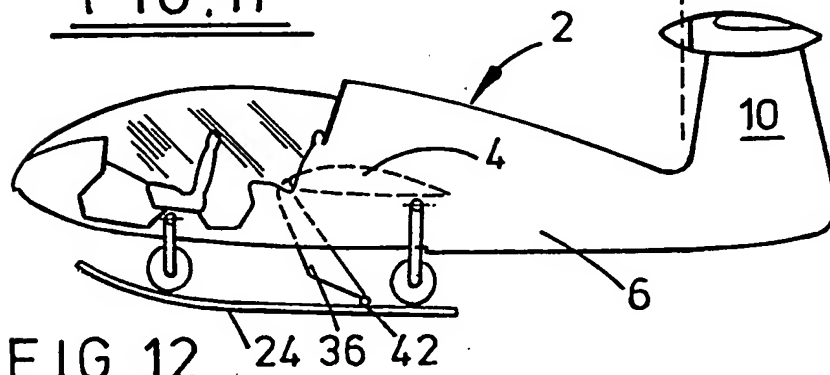


FIG. 12

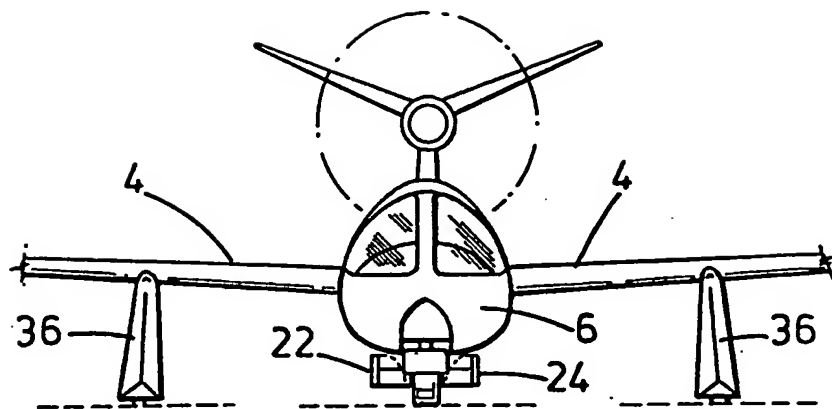


FIG. 13

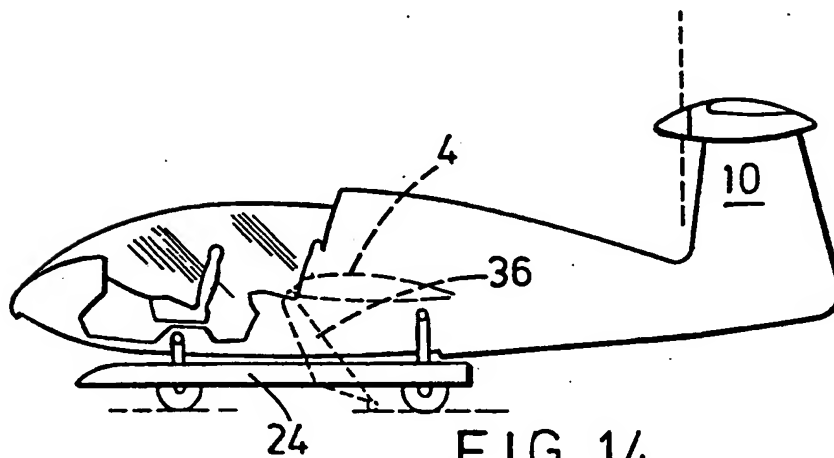
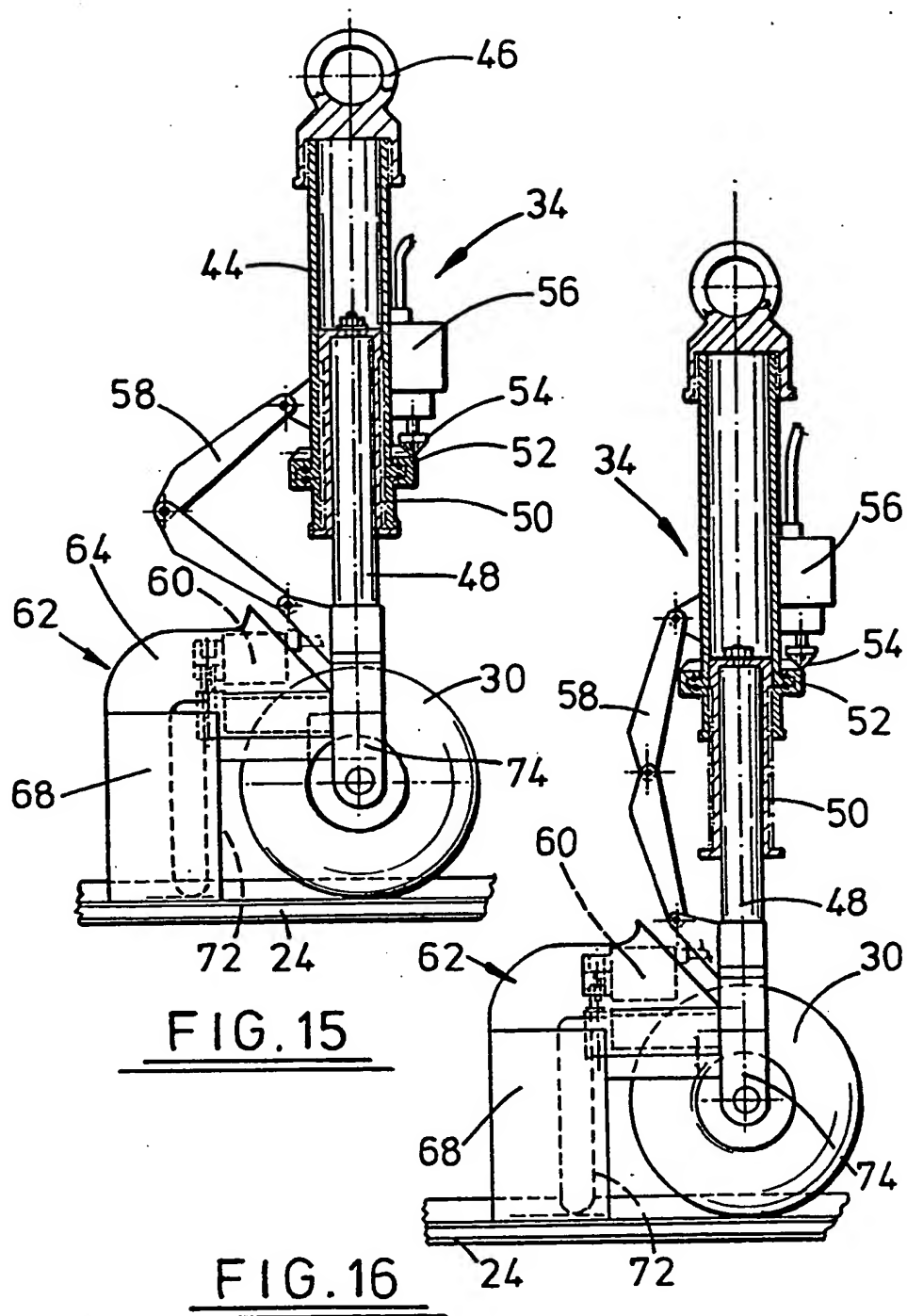
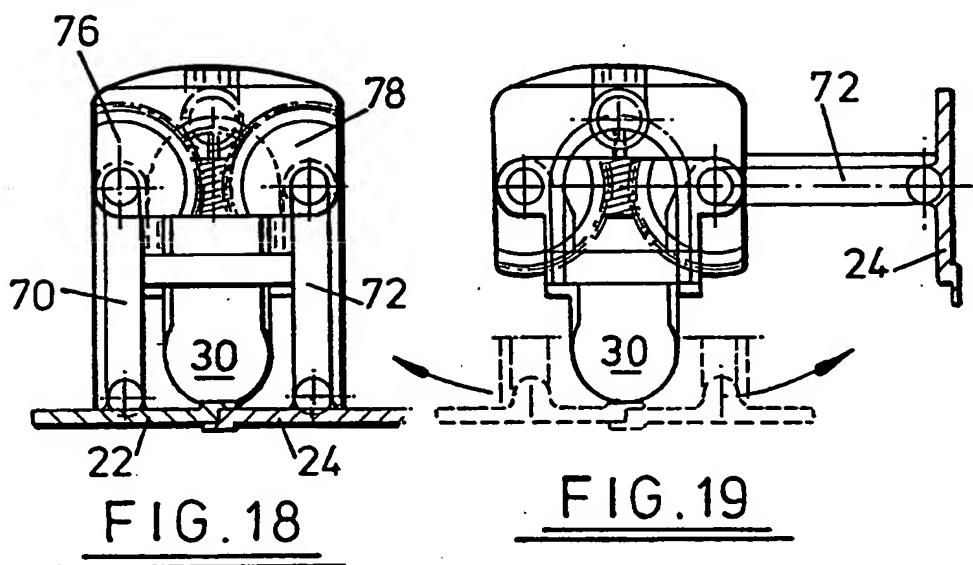
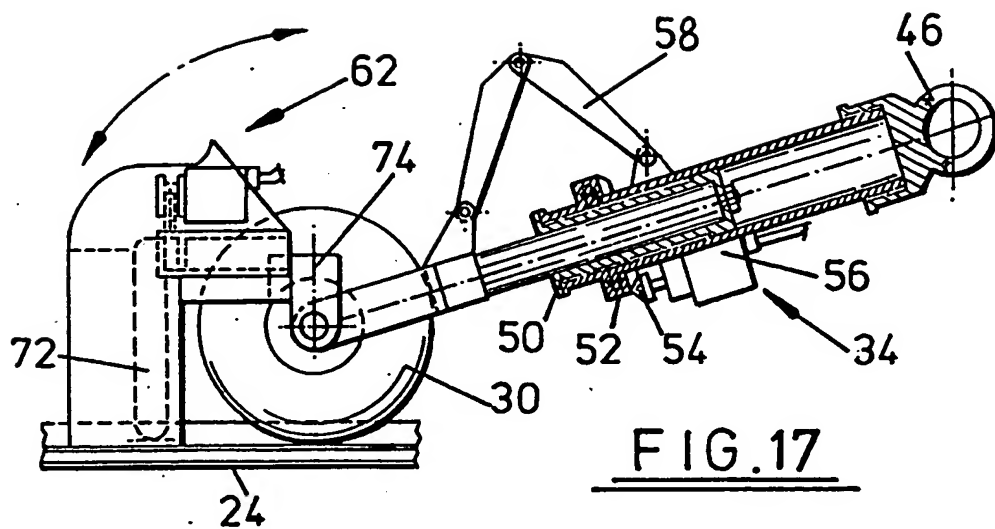


FIG. 14





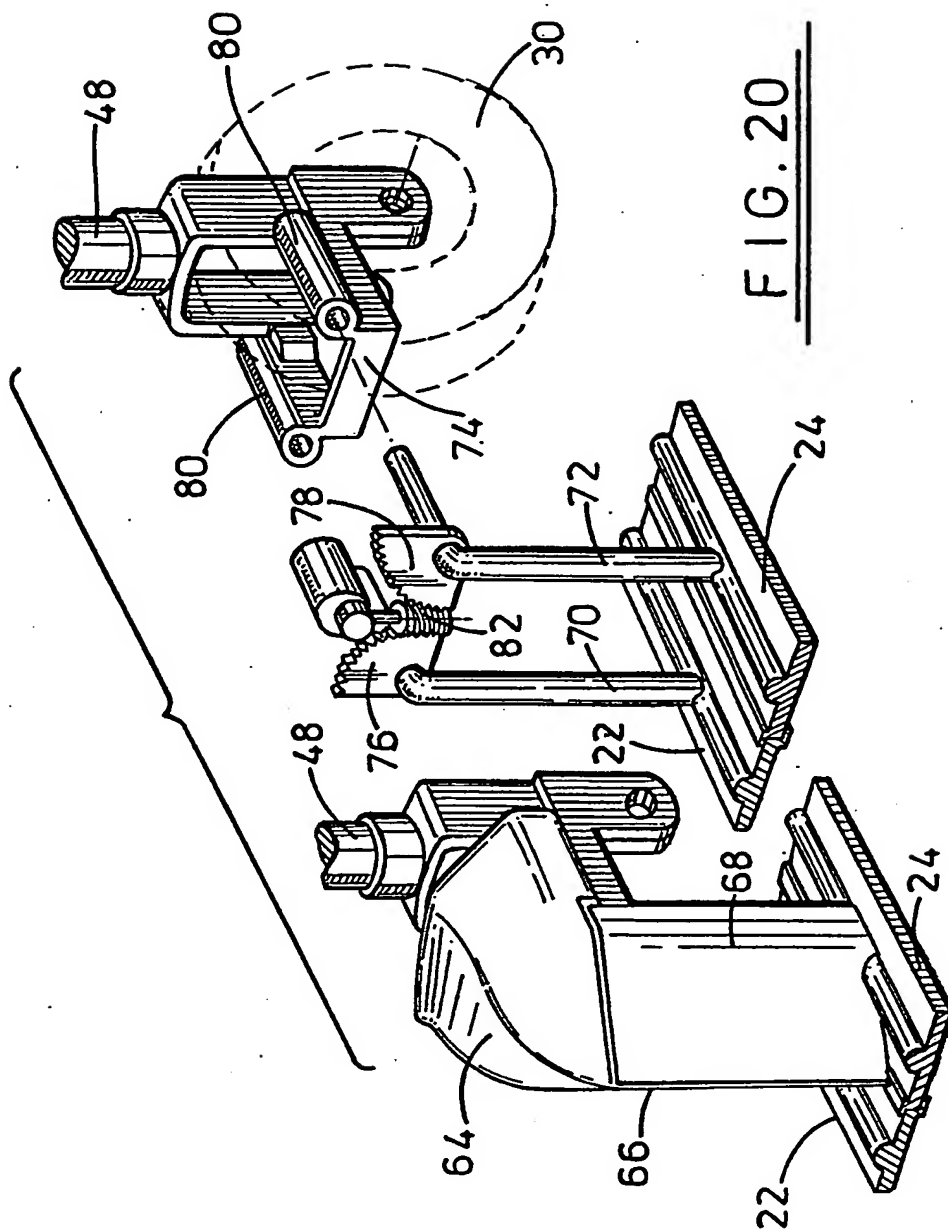


FIG. 20

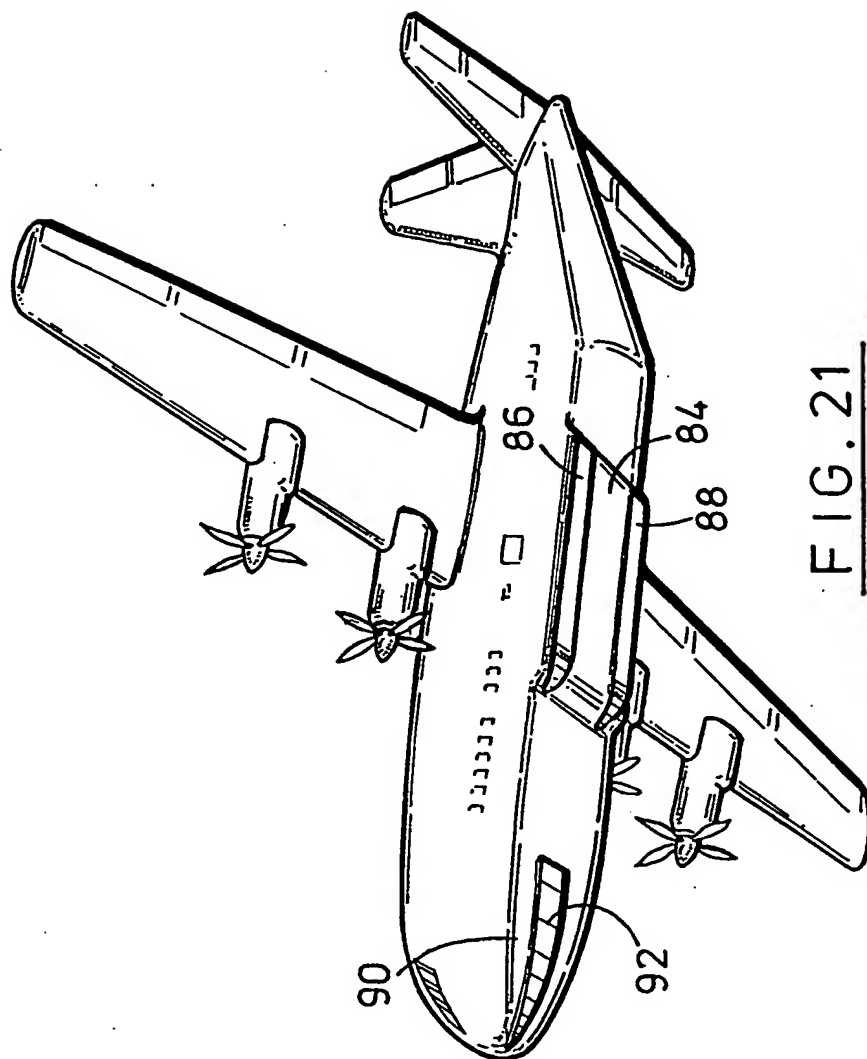


FIG. 21

INTERNATIONAL SEARCH REPORT

 International Application No.
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 A. CLASSIFICATION OF SUBJECT MATTER
 IPC 5 B64C25/52 B64C25/54

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

 Minimum documentation searched (classification system followed by classification symbols)
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C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category *	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	US,A,2 793 827 (RIES) 28 May 1957 see column 1, line 16 - line 34 see column 2, line 65 - line 70 see column 3, line 13 - line 30 see column 3, line 72 - column 4, line 4; figures 1-3,7	1,2
X	US,A,2 753 135 (GOUGE) 3 July 1956 see column 1, line 20 - line 41 see column 1, line 48 - line 49 see column 2, line 11 - line 24 see column 2, line 46 - line 55; figures 1,2,4,5	1
A	---	2,3

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Date of the actual completion of the international search

8 March 1994

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INTERNATIONAL SEARCH REPORT

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Category	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	US,A,2 646 235 (DAWSON) 21 July 1953 see column 1, line 9 - line 22 see column 1, line 52 - column 2, line 2 see column 2, line 54 - column 3, line 6 see column 4, line 1 - line 45; figures 1-6	1
A	-----	3,9,11
X	US,A,3 526 374 (RISKEN) 1 September 1970 see column 1, line 28 - line 31 see column 1, line 45 - line 52 see column 2, line 60 - column 3, line 41 see column 5, line 1 - line 4 see column 5, line 9 - line 13; figures 1-3,10-12 -----	1,6

INTERNATIONAL SEARCH REPORT

Information on patent family members

International Application No.

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Patent document cited in search report	Publication date	Patent family member(s)	Publication date
US-A-2793827		NONE	
US-A-2753135		NONE	
US-A-2646235		NONE	
US-A-3526374	01-09-70	NONE	

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